2009

2008 Annual Report

Center for Coastal Resources Management

Center for Coastal Resources Management

Annual Report 2008

The Center for Coastal Resources Management exists to develop and support integrated and adaptive management of coastal zone resources. To fulfill this mission, the Center undertakes research, provides advisory service, and conducts outreach education. These tasks are carried out by a staff of professional scientists and technical experts using a mix of state funding and grant/contract support.

Center for Coastal Resources Management

2008 Annual Report

Virginia Institute of Marine Science
P.O. Box 1346
Gloucester Point, Virginia 23062

Report Contents

Center Programs

Background

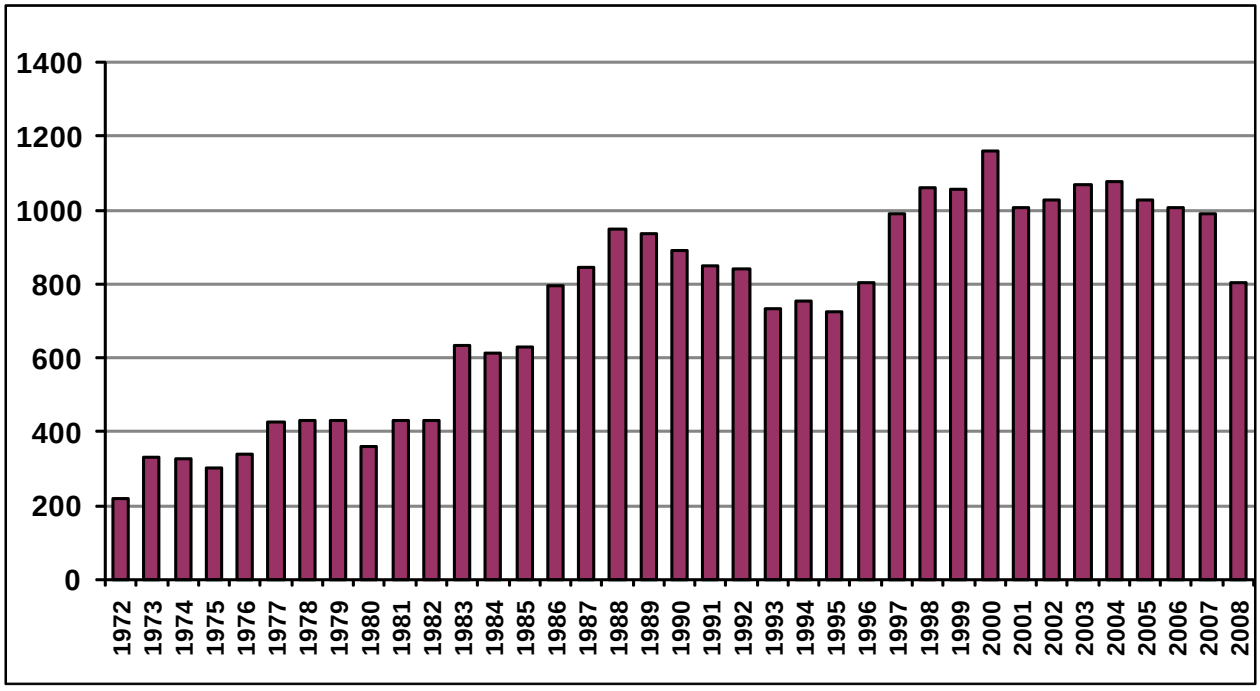
Within its broader mission, the Center has specific tasks to support Virginia's wetlands and shoreline management programs. These core activities create a natural focus on the littoral zone and riparian lands in coastal and estuarine areas. Management of resources in these areas has evolved from resource-specific considerations to system-level perspectives. The Center has been an active agent in this change, and has developed the required internal capabilities and external collaborations to support multidisciplinary approaches to management and policy issues.

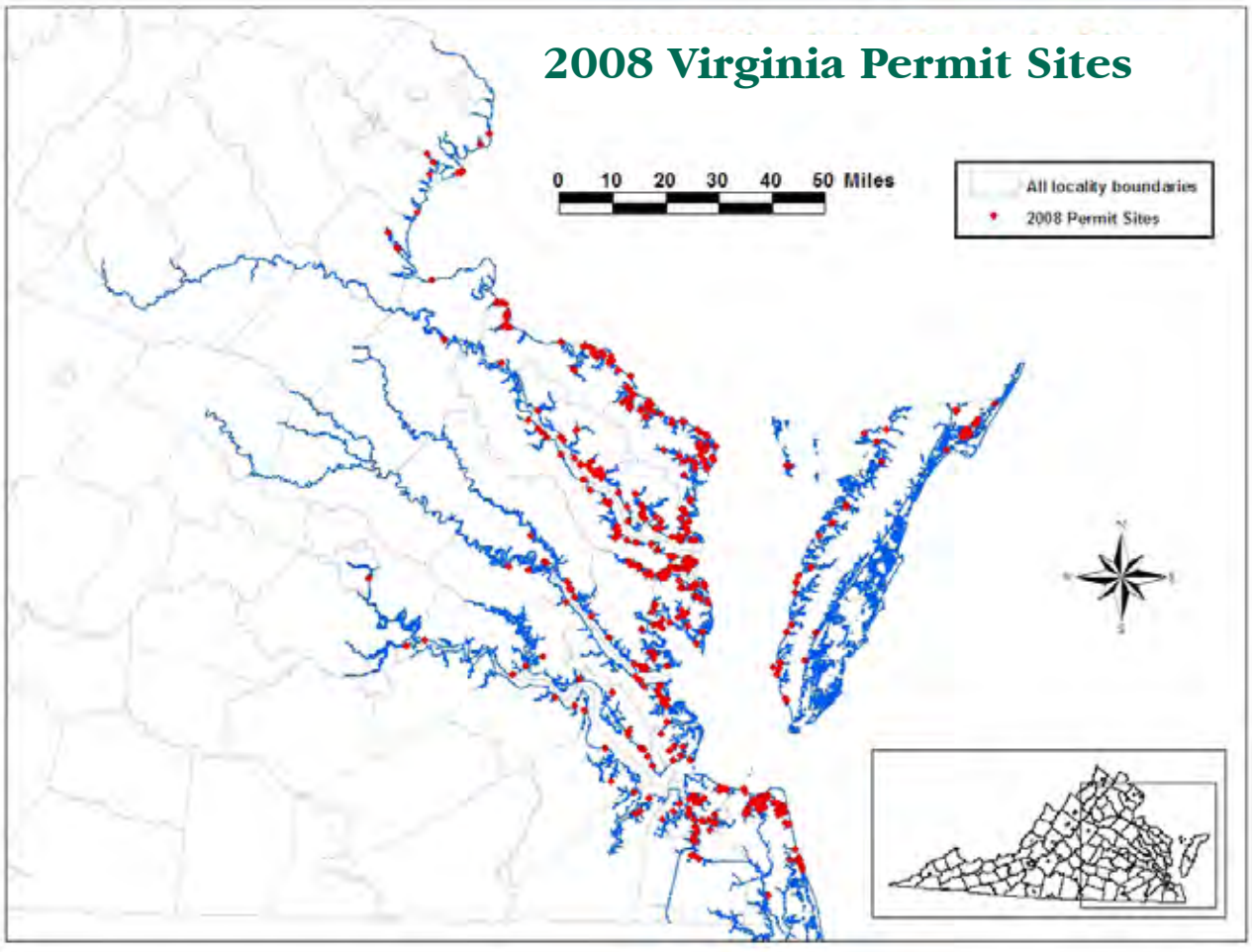
The Center currently manages its multiple activities within three broad and interacting programs: The Wetlands Program, Coastal Inventory Program, and Coastal Watersheds Program.

The Wetlands Program

The Wetlands Program deals with both tidal and nontidal wetlands. The program conducts basic research on the structure and functions of these systems, collaborating with researchers throughout the mid-Atlantic region. A wide variety of applied research is also undertaken. This includes policy option analysis, functional assessment methods, inventory and monitoring techniques, and creation/restoration protocols. The Wetlands Program provides extensive support to the Commonwealth's tidal wetlands and subaqueous lands management programs through review of individual tidal wetland permit applications, training for local and state managers, and development/ management of data bases supporting and tracking regulatory program activities.

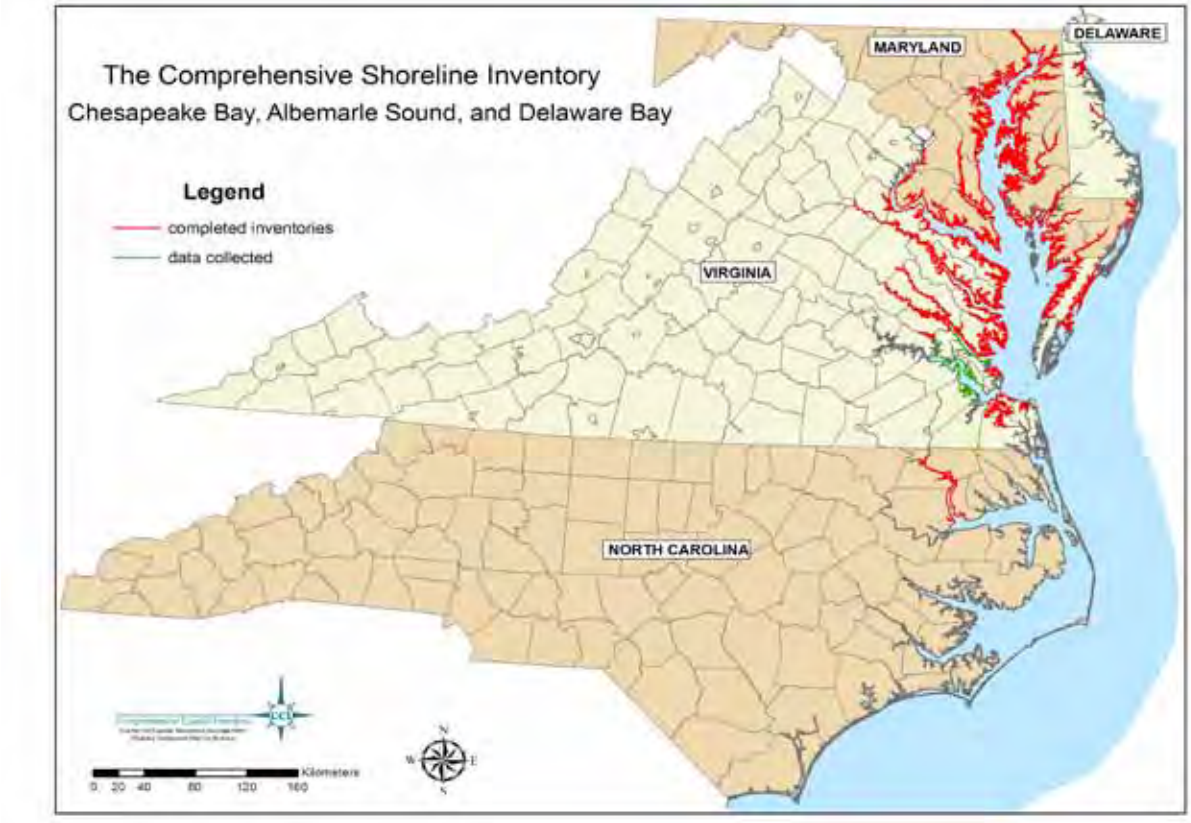
Permits Reviewed 1972 - 2008





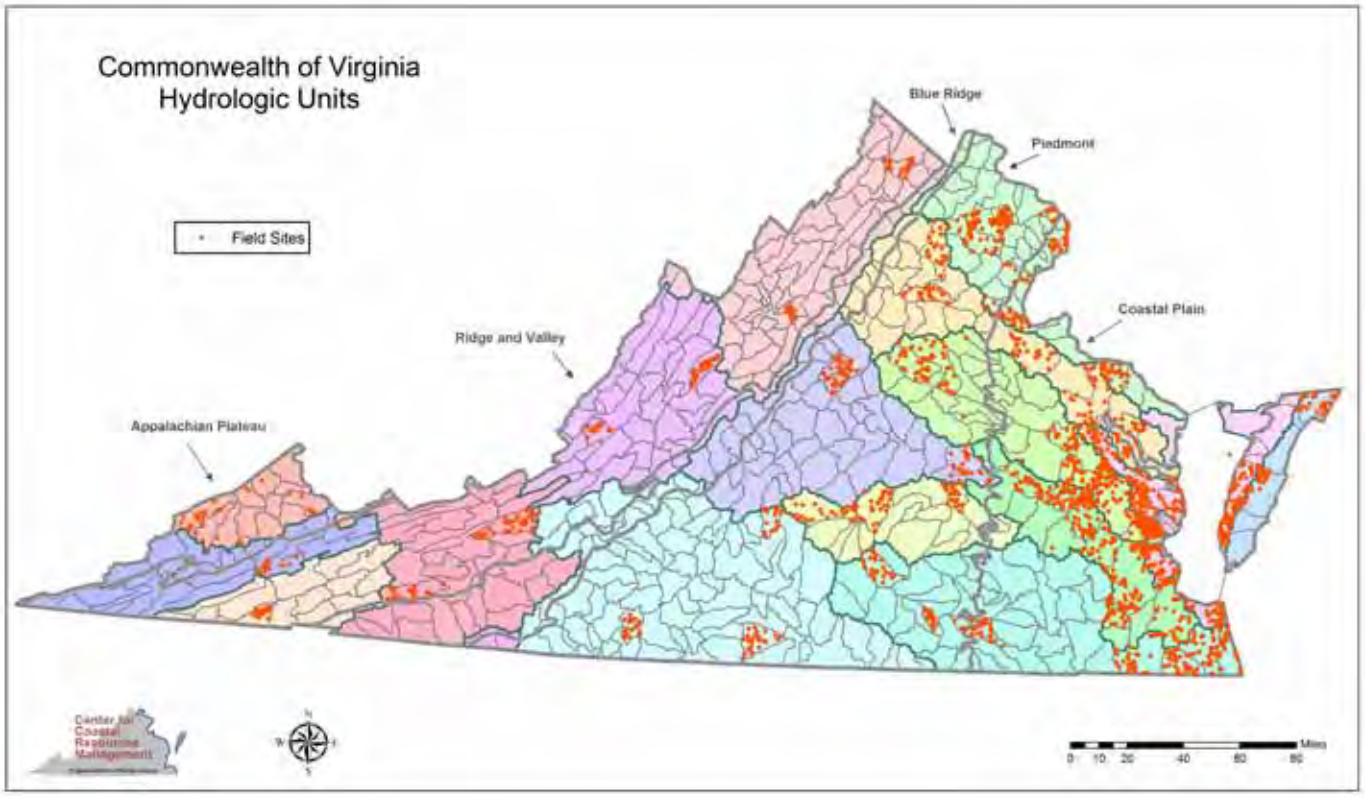
Coastal Inventory Program

The Coastal Inventory Program has a basic mission to monitor tidal shoreline conditions and to develop policy/management recommendations based on analysis of that information. The Coastal Inventory Program has developed extensive capabilities in geographic information systems and in analysis of remotely sensed information. It has expanded its inventorying activities to include almost all terrestrial and aquatic resources within the coastal zone in support of the Center's focus on integrated and adaptive management. Development of GIS-based analytical protocols has become a major activity in the Coastal Inventory. Development of these tools has proven to be a most effective mechanism for integrating technical understanding and extensive data sets in a format that is comprehensible and informative for managers. The Coastal Inventory generates detailed shoreline condition inventories for every tidal county and city as part of its basic mission, and shares its extensive GIS data bases with state and federal agencies throughout the region.



Coastal Watersheds Program

The Coastal Watersheds Program evolved to deal with the water quality/quantity, land use, and habitat issues that were part of integrated management of coastal resources. The program focuses on basic and applied research in support of policy and regulation development. There are both regional and international elements in the Coastal Watershed Program. The program is working on development of indicators for health of aquatic ecosystems, use conflict management plans for shallow waters, anadromous fish spawning and nursery habitat studies, and climate change impact assessments. Because much of the work on use conflict analysis, shallow water management, and fishery habitat assessment is of interest in coastal systems around the world, the Center manages growing international collaborations through the Coastal Watersheds Program.



Personnel and Funding

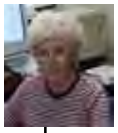
The Center has a full time staff of about 23 individuals and supports several graduate students. The staffing varies slightly depending on grant and contract activities. Currently the Commonwealth of Virginia provides base funding for the Center that covers less than 50% of the salary expenses and about 15% of the annual operating expenses. The balance of funding is derived from grant and contract activity. The primary sources of this support have been the U.S. Environmental Protection Agency and Virginia's Coastal Resource Management Program (funding from NOAA). Other sources of recent funding have included National Oceanic and Atmospheric Administration, National Science Foundation, Virginia Department of Health, Virginia Department of Conservation and Recreation, and private donors.

Center for Coastal Resources Management

John Wells
VIMS Dean and Director

Roger Mann
Director for Research and Advisory Service

Carl Hershner
Director, Center for Coastal Resources Management



Agnes Lewis
Business Manager A

Dawn Fleming
Administrative Coordinator

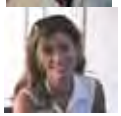
Vacant
Administrative Assistant

Comprehensive Coastal Inventory

Marcia Berman
Program Director

Harry Berquist
Sr. Programmer/ Analyst

Mary Huang
Graduate Intern



Karinna Nunez
Programmer Analyst

Tamia Rudnicky
Programmer/Analyst

Dave Weiss
Database Manager

Julie Herman
Assistant Research Scientist

Sharon Killeen
Programmer/Analyst

Dan Schatt
Programmer/Analyst

Coastal Watersheds Program

Kirk Havens
Assistant Director, CCRM

Donna Bilkovic
Research Assistant Professor

Karen Reay
Internet Database Manager

Dave Stanhope
Scientist II

Kory Angstadt
Scientist II

Wetlands Program

Julie Bradshaw
Scientist III

Karen Duhring
Scientist III

Pam Mason
Scientist III

Molly Roggero
Scientist III

Christine Breddy
Scientist II

Vacant
Scientist I

Center Fellows

The Center Fellowship Program is designed to enhance capabilities to provide the very best research and advice by ensuring a constant influx of new ideas and perspectives. The goal is to bring dynamic young scientists into close collaboration with Center staff on a continuing basis. Each Fellow is expected to spend a minimum of one week in residence at the Center giving seminars and leading workshops in areas of their particular expertise. In addition, Fellows are engaged in development of proposals for collaborative research that may extend well beyond their formal appointments. Fellows are selected by the Center's leadership based on nominations from Center staff or colleagues at other institutions. The selection process emphasizes the goal of bringing in post-doctoral scientists who have begun careers as independent researchers, with expertise that compliments but does not duplicate Center staff expertise. Fellowship Program success is measured by the number of new research topics and approaches developed from these collaborations. These appointments started on May 1, 2004.

Dr. Anamarija Frankic is an assistant professor in the Environmental Earth and Ocean Science Department of the University of Massachusetts in Boston. She is interested in coastal ecosystem management, and particularly in adaptive management applications to establish sustainable practices in coastal environments. Dr. Frankic is currently teaching and conducting research on management of aquaculture, protected areas, and tourism/ecotourism. She has worked as a consultant for the World Bank and Global Environment Facility on a variety of ecosystem conservation projects in Croatia, and has been an active participant in workgroups sponsored by the United Nations. She has worked with CCRM staff in establishing collaborations with coastal centers in Croatia and Ireland, and has directed and/or participated in research projects focused on integrated coastal management involving CCRM staff and students.

Dr. Chris Pyke is the Director of Climate Change Services for CTG Energetics, Inc., a team of engineers, architects, planners, and scientists dedicated to integrating sustainability principles with the design and operation of the built environment. Dr. Pyke serves as a member of the Chesapeake Bay Program's Scientific and Technical Advisory Committee. Collaboration with VIMS researchers provides opportunities

for Dr. Pyke to pursue his interests in interactions between climate and land use change, particularly decisions associated with land management and the design and operation of built environments. Dr. Pyke has also worked with VIMS researchers on several proposals to investigate climate-related impacts and adaptation opportunities associated with coastal land use practices as well as a study on climate change for the Chesapeake Bay Program..

Dr. Denice Wardrop is a research faculty member in the Cooperative Wetlands Research Center at Pennsylvania State University. Dr. Wardrop has been engaged in investigation of nontidal wetlands structure and function in the ridge and valley province of Pennsylvania. She has also been an active participant in a number of technical advisory committees at the state, regional, and federal level, including the national committee on Biological Assessment of Wetlands. Dr. Wardrop's expertise is particularly important to the VIMS' Center staff as they undertake development of new wetlands assessment protocols for the Commonwealth of Virginia. She is currently collaborating with the VIMS' researchers in a multi-institutional project to develop indicators of aquatic ecosystem health. This work is now evolving to pursue related lines of research through new proposals.

Center Adjunct Research Faculty

CCRM Adjunct Research Faculty are College of William and Mary colleagues from other departments or schools. These individuals collaborate with Center staff on a continuing basis in basic and applied research. Adjunct Research Faculty expand the expertise available for CCRM projects, constituting a very efficient mechanism for addressing multidisciplinary issues. Appointments are for fixed terms and are renewable as the work of the Center and the interest of faculty members dictate. Success in the Adjunct Research Faculty program is judged by generation of collaborative proposals and research products. The first appointments to the CCRM Adjunct Research Faculty were made in December 2005.

Dr. Randy Chambers is Associate Professor of Biology and Director of the Keck Environmental Field Laboratory at The College of William and Mary. His research interests are in environmental science and the ecology and restoration of wetlands. Currently, he teaches courses in watershed ecology, environmental sicence and policy, and wetland ecosystems. Dr. Chambers'

most recent projects include an evaluation of invasive plants in tidal wetlands, long-term research in the Florida Coastal Everglades, and the study of turtles in southeastern Virginia wetlands.

Dr. Gregory Hancock is Associate Professor of Geology at the College of William and Mary. A geomorphologist and hydrologist, Dr. Hancock is interested in the impacts of land use change on Coastal Plain streams, and the effectiveness of engineered structures (i.e. retention ponds) on minimizing these impacts. He is collaborating with James City County to evaluate the effectiveness of retention ponds for controlling stormwater runoff, and is investigating the impacts of urbanization-induced channel incision on local riparian groundwater systems.

Center Associate Researchers

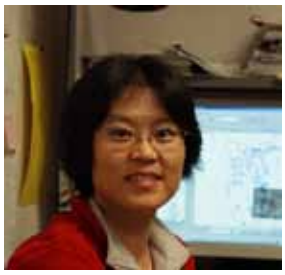
CCRM Associate Researchers are scientists from other institutions, government agencies, and/or the private sector who collaborate with Center staff on research and advisory projects. Appointment as an Associate Researcher is based on sustained productive interaction. Appointments are for fixed terms and renewable as appropriate. The first appointments of CCRM Associate Researchers were in September 2005.

Daniel Redgate is an Environmental Scientist at Blueskies Associates, Inc. His research interests include Hydrology, Assessment and Restoration of Streams and Wetlands; Watershed Modeling, Assessment and Water Quality Improvement. Dan is presently working as a consultant in the assessment and design of stream and wetland ecosystems, and in the evaluation of watershed-scale water quality improvement measures. While studying for his Master's degree at VIMS, Dan's research focused on the hydrology of forested wetlands and seasonal water budgets of forested wetland mineral flats. Dan has since worked on the assessment and design of numerous wetland and stream restoration sites for the purpose of compensatory mitigation and for watershed water quality improvement.

Dr. Ed Sharp is currently working on developing methodologies for the use of thermal imaging in natural resource research. He formerly conducted basic research in the area of applied nonlinear optics at the U.S. Army Night Vision & Electro-Optics Laboratory and the U.S. Army Research Laboratory. His major areas of interest include laser crystal

physics, thermal imaging materials and devices, electro-optic and nonlinear-optical processes in organic materials, beam-control devices, optical solitons, harmonic generation, holographic storage, and photorefractive effects in ferroelectric materials. Dr. Sharp is the author or co-author of more than 100 technical publications and holds over 15 patents on optical materials and devices.

Center Graduate Students



Mary Huang - Mary is a Ph.D. candidate at the Virginia Institute of Marine Science focusing on analyzing fecal coliform data collected by Department of Shellfish Sanitation and developing a quantitative model to estimate fecal bacteria loading from different land covers. The results of this work may have an impact on the development of shellfish total maximum daily loads (TMDLs) in Virginia.

Karinna Nunez - Karinna is a MS candidate for the College of William and Mary/Virginia Institute of Marine Science. She is developing a shoreline change forecast and wetland response model for Dorchester County, MD, to evaluate the vulnerability of wetlands to shoreline erosion and inundation due to sea level rise. While pursuing an advanced degree, Karinna also works for CCRM as a GIS Programmer/Analyst. Her research interests include GIS technology and remote sensing, sustainable development management in coastal areas, and water quality issues.

Center Collaborations

Albemarle Pamlico National Estuary Program

Baltimore District Corp of Engineers

Chesapeake Bay National Estuarine Research Reserve

College of William and Mary

Delaware Department of Natural Resources & Environmental Control

East Carolina University

Longwood University

Maryland Department of the Environment

Maryland Department of Natural Resources

NOAA Chesapeake Bay Program Office

NOAA Coastal Services Center

North Carolina Coastal Federation

Oregon State University

Pennsylvania State University

Smithsonian Environmental Research Center

U.S. Coast Guard

U.S. Coast Guard Auxiliary

U.S. Dept of the Army, Night Vision & Electro-optics Div. (retired)

U.S. Environmental Protection Agency

University College Cork, Ireland

University of Maryland

University of North Carolina

University of Washington

Virginia Department of Conservation & Recreation

Virginia Department of Forestry

Virginia Polytechnic Institute and State University

Wetlands Watch

Center Projects

Assessment of Aquaculture Potential Within Baylor Grounds in the Lower Rappahannock River

Principal Investigator: Berman
Funding Agency: VA Coastal Zone Management Program
Period: 10/30/07-9/30/08
Amount: $60,000

The suitability for using public Baylor grounds for aquaculture is being explored through a GIS based analysis to determine if areas could support aquaculture given current condition and surrounding land-use.

http://ccrm.vims.edu/publications/pubs/LowerRappAquaculture.pdf

Climate Impacts in VA: Status of Natural Resource Data Records as Tools to Assess Continuing Trends

PI: Berman, Hershner
Funding Agency: VEE
Period: 04/01/08-03/31/09
Amount: $40,000

This project reviews existing databases that contain information which would be useful for assessing trends in natural resources which may be driven by climate change impacts. The final product will be a bibliography of sources that span academic, private, federal, state, and local government agencies.

Development of Maryland's Living Shoreline Training Manual

Principal Investigator: Berman
Funding Agency: MD Department of Natural Resources
Period: 3/30/08 - 7/30/08
Amount: $9,600

This project developed a training manual to guide end users in the use and dissemination of data contained within the Living Shoreline Model developed for Worchester County Maryland.

Development of Shoreline Inventories for Delaware

Principal Investigator: Berman
Funding Agency: DE Department of the Environment and Environmental Control
Period: 6/1/07-2/30/08
Amount: $30,000

This project generates a shoreline inventory for three watersheds in the state of Delaware: St. Jones, Appaquinamink, and Blackbird Creeks.

http://ccrm.vims.edu/gis_data_maps/shoreline_inventories/delaware/delaware_disclaimer.html

Effects of Sea Level Rise on Tidal Wetlands

Principal Investigator: Berman
Funding Agency: VA Environmental Endowment
Period: 10/1/07-9/30/2008
Amount: $31,462

This project maps the anticipated loss of tidal wetlands habitat in the Lynnhaven River watershed attributed to sea level rise. The project uses remote sensing techniques and high-resolution imagery to delineate current wetlands distribution. High-resolution elevation data generated from LIDAR will be used to compute the horizontal and vertical inundation due to sea level rise.

Erosion Vulnerability Assessment and Planning Tool

Principal Investigator: Berman
Funding Agency: United States Army Corps of Engineers - Baltimore District
Period: 08/01/06 – 06/01/08
Amount: $126,776

The Erosion Vulnerability Assessment (EVA) and Planning Tool was initiated to assist with decision making along the Chesapeake Bay portion

of Maryland's tidal shoreline. EVA is an assessment of ecological and socioeconomic resources that may be vulnerable to shoreline erosion processes occurring along the Maryland portion of the Chesapeake Bay. The analysis uses historic shoreline change rates combined with an inventory of current shoreline conditions to predict the position of the shoreline in 50-years. The location of various resources with respect to that predicted 50-year shoreline was evaluated, and an interactive map tool was produced for visual display and data access.

http://ccrm.vims.edu/gis_data_maps/interactive_maps/erosion_vulnerability/index.html

Geographic Information Support to Chesapeake Bay Erosion Feasibility Study, Maryland

Principal Investigator: Berman
Funding Agency: Baltimore District US Army Corps of Engineers
Period: 8/8/2006-1/31/2008
Amount: $125,000

This project determines the risk to natural habitat (beaches and marshes), and socio-economic resources that can be attributed to shoreline erosion. The project also looks at the influence boat wake activity has on shoreline erosion in protected embayments. The degree of vulnerability will be determined using a GIS based spatial model. The output will be displayed in an interactive map environment.

http://ccrm.vims.edu/gis_data_maps/shoreline_inventories/index.html

Internet Based Decision Tool for Siting Wetland Restoration Sites in Hampton Roads, Virginia

Principal Investigator: Berman
Funding Agency: US Environmental Protection Agency, in-house
Period: 2005-2008
Amount: $82,361

Revised in 2005, the update now includes Virginia's entire coastal zone. This project uses the protocol and findings of the Advanced Identification of Wetland Restoration sites, to develop an interactive, web-based management tool to assist regulators, developers, and project agents in location of potential compensatory mitigation sites in Hampton Roads. The model has been run for the entire coastal zone in Virginia.

http://ccrm.vims.edu/publications/completed_projects/wetlands/internetdecisiontool.html

Living Shoreline Suitability Modeling - Calvert and Somerset Counties Maryland

Principal Investigator: Berman
Funding Agency:NOAA
Period: 10/01/08-10/01/2009
Amount: $49,515

This project extends the Living Shoreline Suitability Model to two additional counties in Maryland. The model will be run in Calvert and Somerset counties and the model output will be mapped and added to the Maryland Shorelines Online project. For more details on the Living Shoreline Suitability Model see the Living Shoreline Suitability Model – Worcester County, Maryland.

http://ccrm.vims.edu/livingshorelines/projects/index.html

Living Shoreline Suitability Modeling - Worcester County Maryland

PI: Berman
Funding Agency: MD Department of Natural Resources
Period: 11/01/07-9/30/2008
Amount: $37,000

This project applies a living shoreline suitability model to the county of Worcester to generate a coastal management strategy map delineating areas suitable for living shoreline treatments.

http://ccrm.vims.edu/livingshorelines/projects/index.html

Mathews County Shoreline Management Plan

PI: Berman
Funding Agency: NFWF
Period: 1/01/08-3/31/2009
Amount: $56,095

This project develops a shoreline management plan for the County of Mathews, Virginia. The project includes the development of a Shoreline

Inventory which report current shoreline condition, and recommendation for strategies to management shoreline erosion. The project is a collaborative effort with the County government.

Occahannock Creek Shoreline Management Plan

Principal Investigators: Berman, Hardaway
Funding Agency: NFWF / Eastern Shore of VA Resource Conservation & Dev. Council
Period: 4/1/07-10/31/07
Amount: $40,000

This project develops a shoreline inventory for Occahannock Creek and generates a Shoreline Management Plan to assist with local planning and shoreline management strategies.

Shellfish Aquaculture Suitability Model

Principal Investigator: Berman
Funding Agency: VA Coastal Resources Management Program
Period: 10/1/2006-9/30/2007
Amount: $85,000

Using GIS, a landscape model will be developed to delineate areas suitable for shellfish aquaculture. This model will consider physical and biological parameters associated with good shellfish growing areas, as well as upland land use considerations that can enhance or impede the success of an aquaculture operation. The model will be developed using GIS and final products will include an interactive mapping site to display the suitable areas. This project expands on earlier efforts to explore shallow water use conflicts in Virginia.

http://ccrm.vims.edu/gis_data_maps/interactive_maps/aquaculture_vulnerability/aquaculture_vulnerability_model.html

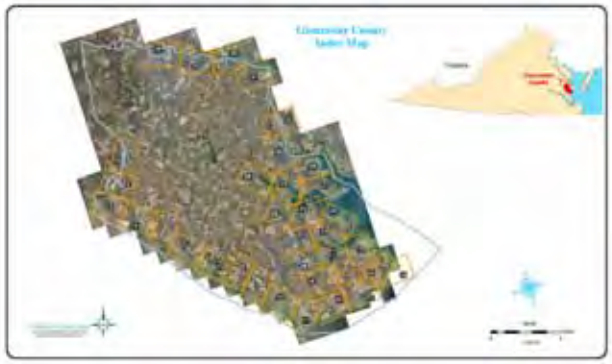
Shoreline Inventory Reports for Tidewater Localities: Phase 2

Principal Investigator: Berman
Funding Agency: VA Coastal Zone Management Program
Period: 10/1/2007-9/01/2008
Amount: $37,500

This project extends the development of Shoreline Inventories into two additional localities in Virginia. They are York County and the City of Newport News. Data for both areas had been

previously collected in earlier years. The project addresses data processing and completes the publication phase of the inventory development. For similar products see GIS Maps & Data - Shoreline Inventories -

http://ccrm.vims.edu/gis_data_maps/shoreline_inventories/index.html



Shoreline Situation Reports for Tidewater Locations

Principal Investigator: Berman
Funding Agency: VA Coastal Zone Management Program
Period: 10/1/2007-9/01/2008
Amount: $50,000

This project completes necessary steps to generate new Shoreline Inventories for the City of Chesapeake, City of Portsmouth, County of Gloucester, County of New Kent, and County of King George.

http://ccrm.vims.edu/gis_data_maps/

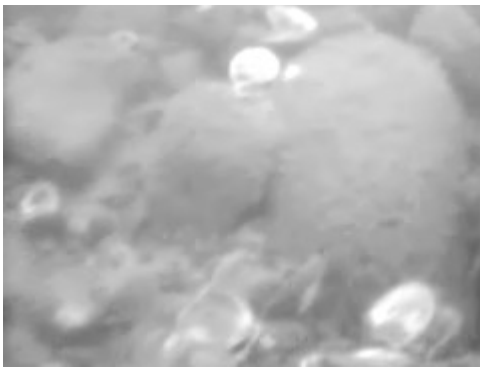
Virginia Shoreline Classification

Principal Investigators: Berman, Herman
Funding Agency: unfunded
Period: 9/15/05 - present

Using basic geomorphic characteristics of the coastal landscape, the shoreline of coastal plain of Virginia is being classified. The selected characteristics will serve as indicators of shoreline stability, potential management strategies, and current and future vulnerability. This is a regional assessment and is not intended for application to parcel level shoreline management issues.

http://ccrm.vims.edu/publications/pubs/shoreline_project_elements_3.pdf

Sturgeon Spawning Habitat on the James and Appomattox Rivers



Principal Investigator: Bilkovic
Funding Agencies: US Fish and Wildlife Service
Periods: 11/01/05-present
Amount: $12,945

This project's objectives are to conduct bottom mapping of potential Atlantic sturgeon spawning reaches using side scan sonar to ascertain the presence and location of essential spawning habitat (e.g. gravel beds) in the James and Appomattox rivers. Areas surveyed include the upper reaches of the James River from Shirley Plantation to Richmond; as well as the Appomattox River from the mouth to the Colonial Heights Bridge.

http://ccrm.vims.edu/research/mapping_surveying/sturgeon/index.html

Survey of Atlantic Sturgeon Spawning Habitat on the James River

Principal Investigator: Bilkovic
Funding Agency: US Fish and Wildlife Service, NOAA Chesapeake Bay Program
Period: 11/01/05 - 5/31/07 (USFWS), 10/01/07 - present (NOAA-CBO)
Amount: $12,945 (USFWS), $20,000 (NOAA-CBO)

This project's objectives are to conduct benthic habitat mapping of potential Atlantic sturgeon spawning reaches using side-scan sonar to ascertain the presence and location of essential spawning habitat (e.g. gravel beds) in the James River. Areas surveyed include the upper reaches of the James River from Shirley Plantation to Richmond. The location of viable hard bottom habitats for sturgeon spawning will be determined and geo-referenced for future evaluation with additional habitat quality information.

http://ccrm.vims.edu/research/mapping_surveying/sturgeon/index.html

Surveying and Summarizing the Spatial Arrangement of Benthic Habitat Types within the Nearshore of Mobjack Bay, Virginia

Principal Investigators: Bilkovic, Hershner
Funding Agency: NOAA Chesapeake Bay Program
Period: 9/01/06-8/31/08
Amount: $68,581

Mobjack Bay and its associated tributaries historically contained a diverse array of critical habitat types including oyster reefs, seagrass beds and tidal wetlands. Currently, multiple restoration efforts are underway throughout this watershed to mitigate losses from disease, and habitat destruction and modification. Benthic habitat will be mapped and quantified within the nearshore of Mobjack Bay, including the Severn, Ware, North and East Rivers, and compared with described aquatic habitat distribution (e.g. SAV, tidal marsh) from other sources (CCRM, wetlands program and VIMS SAV program), to characterize the extent and distribution of habitats.

http://ccrm.vims.edu/research/mapping_surveying/mobjack_bay/index1.html

Tidal Wetlands Management Technical Support

Principal Investigators: Fleming, Hershner
Funding Agency: VA Coastal Zone Management Program / NOAA
Period: annually 10/1-9/30
Amount: $84,000

This project has been a continuing grant renewed annually to support advisory service provided by the Wetlands Program to the Tidal Wetlands Management program. In particular, this grant helps fund travel costs associated with site visits and meeting attendance by staff scientists, publication costs for wetlands newsletters and outreach education materials, as well as some of the expenses of maintaining the tidal wetlands permit database on the Center's website.

http://www.vims.edu/ccrm/wetlands/newpermits.html

Funding was provided to support production of the following publications:

- Virginia Wetlands Report. Spring 2008, Vol. 22, Issue 1. Living on the Edge http://ccrm.vims.edu/publications/publications_topics/index.html
- Virginia Wetlands Report. Fall 2008, Vol. 22, Issue 2. The Big Picture: Managing Wetlands from a Shoreline Perspective http://ccrm.vims.edu/publications/publications_topics/index.html
- Rivers & Coast. Winter 2008, Vol. 2, No. 1. Introduction to the Integrated Guidance Concept http://ccrm.vims.edu/publications/pubs/rivers&coast/index.html

Living Shoreline Design and Construction Manual

Principal Investigators: Hardaway, Milligan, Duhring
Funding Agency: NOAA
Period: 10/01/08 – 09/01/09
Amount: $10,079

This project will develop a manual that will provide design and construction guidance for contractors, coastal managers, planners, local governments, homeowners and those interested in sound shoreline management. The manual will incorporate graphics and guidelines produced for an on-line course completed in 2008. Integrated shoreline management across jurisdictional habitats and maximizing ecosystem services of vegetated coastal habitats are the guiding principles for the manual.

Blue Crab Mortality in the Chesapeake Bay Due to Derelict "Ghost" Crab Pots

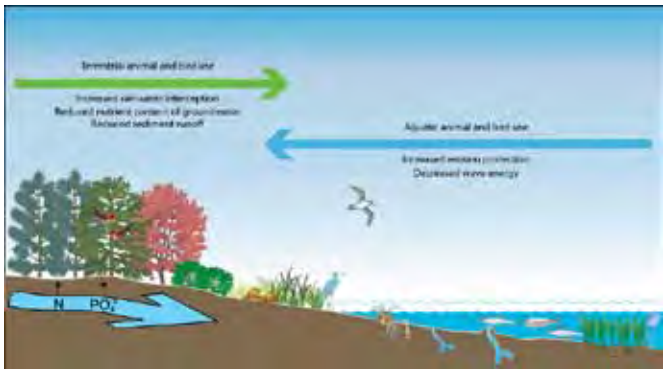
Principal Investigators: Havens, Bilkovic, Stanhope, Angstadt
Funding Agency: NOAA / National Fish & Wildlife Foundation
Period: 01/10/07 – 12/31/07
Amount: $35,022

This project investigates blue crab mortality rates associated with abandoned or derelict blue crab traps in the Chesapeake Bay including the 'self-baiting' phenomenon of derelict traps. The study is both field and laboratory based.

http://ccrm.vims.edu/research/mapping_surveying/marine_debris.html

Developing a Curriculum for a Living Shorelines Education Course for Project Designers and Contractors

Principal Investigators: Havens, Roggero, Bradshaw
Funding Agency: Chesapeake Bay Restoration Fund
Period: 7/01/07 - 7/01/08
Amount: $14,000



This project involves designing curriculum for a course to educate shoreline project designers and contractors about the use of "Living shoreline" designs. The course stresses the reasoning behind the recommended design criteria, so that participants learn why the designs function naturally, not just how to build them. The course also stresses interactions between the upland riparian zone, the wetlands and the aquatic system - three areas that are functionally integrated and tend to be impacted by shoreline projects.

http://ccrm.vims.edu/education/ls_design_class/index.html

Determination of Minimal Instream Flow for Recreational Use

Principal Investigators: Havens, Hershner, Berquist
Funding Agency: in-house
Period: ending in 6/09

Recreational canoeists established a network of gages in the 1970's that reflect stream levels on Virginia's rivers. This network of gages depicts at what level canoeing would become impracticable. As such, this is a potential measure of minimal instream flow requirements for recreational boating. This project uses the established network of gages and GPS technology to tie them to elevation benchmarks in order to relate the depicted stream levels to USGS stream gage data.

Guidebook Hydrogeomorphic Wetlands Assessment

Principal Investigator: Havens
Funding Agency: EPA/HGM
Period: 10/01/08 – 9/30/09
Amount: $77,747

The objective of this project is to develop a finalized HGM guidebook for coastal plain flats in the Mid-Atlantic. The Mid-Atlantic flats guidebook will provide guidance in determining functions associated with flats for use in the regional regulatory programs. The project task is to combine HGM guidance developed in Delaware and Virginia into a guidebook for the Mid-Atlantic. The final product is a Regional HGM Guidebook for Coastal Plain Flats.

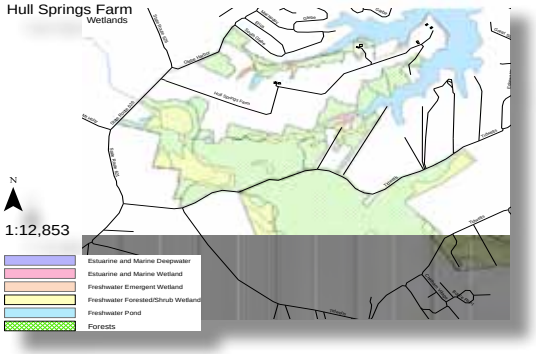
The Impact of the Blue Crab Fishery on the Population Structure of Diamondback Terrapins

Principal Investigators: Chambers, Havens, Stanhope, Angstadt
Funding Agency: National Science Foundation
Period: 04/01/07-3/31/08
Amount: $15,000

This project employs side-scan sonar technology to locate and retrieve derelict blue crab traps adjacent to Goodwin Islands in the York River, Virginia to determine potential impacts on diamond backed terrapins. The Goodwin Island marsh complex is considered good habitat for terrapins.

Longwood College / Hull Springs Farm Wetlands Project

Principal Investigators: Havens, Redgate
Funding Agency: private funds, in-house



Hull Springs Farm is owned by Longwood University Foundation, Inc. The Foundation works closely with the faculty of Longwood University and other universities and groups to coordinate all uses of Hull Springs Farm for educational events and research. Scientists from the Virginia Institute of Marine Science (of the College of William and Mary) have been researching the Farm's hydrology, soil, and biological indicators (for example, plants) to determine areas of the farm that could be restored to wetlands.

Nontidal Wetland Inventory and Monitoring Strategy for Virginia

Principal Investigators: Havens, Hershner
Funding Agency: EPA/DEQ
Period: 02/08/08 - 12/15/08
Amount: $164,565

The project continued to develop a complete wetland monitoring and quality assessment in Virginia's Coastal Plain, Piedmont, Valley and Ridge, Blue Ridge, and Appalachian Plateau physiographic provinces, building on existing work to develop a monitoring and assessment strategy for Virginia. A total of 2,126 Level II calibration sites were visited in the Commonwealth of Virginia (Coastal Plain = 1,326, Piedmont = 602, and Ridge & Valley, Blue Ridge, Appalachian Plateau = 198).

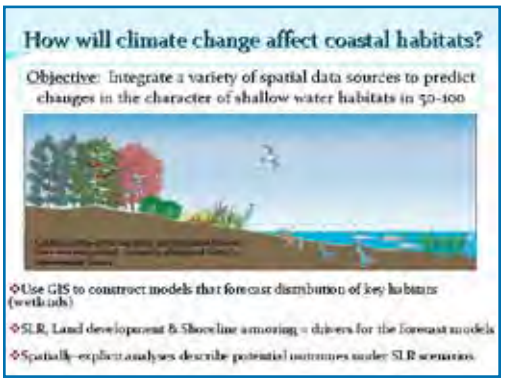
Estuarine Suspended Sediment Loads and Sediment Budgets in Tributaries of Chesapeake Bay

Principal Investigator: Herman
Funding Agency:Army Corps of Engineers
Period: 10/01/08 - 09/30/09
Amount: $48,868

The goals of this project are to calculate sediment transport processes, suspended sediment loads and sediment budgets for the estuarine portions of major tributaries of Chesapeake Bay in Virginia and Maryland. The initial phase will target the York River, VA and the Patuxent River, MD.

Assessing the Potential for Climate-Driven Changes in Virginia's Shallow Tidal Water Habitats

Principal Investigators: Bilkovic, Hershner, Berman, Jasinski
Funding Agency: NOAA Chesapeake Bay Program
Period: 10/01/07-9/30/08
Amount: $120,000



This project is designed to support enhanced stewardship of critical estuarine resources – shallow water habitats. The proposed work will involve integration of a wide variety of data regarding the littoral and riparian areas along Virginia's

estuarine shorelines. The objective is to develop a characterization of current habitat components in the shallow water areas of the Commonwealth. This information will then be used as the basis for modeling potential future conditions in these areas as climate change and development exert their influences.

Building Capacity to Perform Wetland Assessment in Maryland

Principal Investigators: Hershner, Berman
Funding Agency: MD Department of Natural Resources
Period: 3/07-3/08
Amount: $40, 925

This project applies a level 1 non-tidal wetlands assessment protocol for evaluating conditions of wetlands and the probility of ecosystem functions in all of Maryland's mapped nontidal wetlands.

Facilitation of the Development of a Prototype Integrated Ecological Assessment (IEA) Approach for the Chesapeake Bay

Principal Investigators: Hershner, Bilkovic
Funding Agency: NOAA Chesapeake Bay Program
Period: 10/01/07 - 9/30/08
Amount: $30,000

Integrated assessments are defined by NOAA as 'a synthesis and quantitative analysis of information on relevant, physical, chemical, ecological, and human processes in relation to specified ecosystem management objectives'. Inherent in the process of developing integrated assessments is the potential for compounded errors from the use of multiple datasets of varying sources, scales (temporal and spatial), and methodology. To ensure reduction of possible errors and transparency in any analytical assumptions, protocols for development of IEAs need to be developed. This project will review data interpolation and analysis issues encountered in a pilot project that will assess the potential for climate-driven changes shallow tidal water habitat, and work toward development of guidance for future iterations of IEAs in the region.

Garden Club of America Scholarship

Principal Investigators: Hershner, Reay, Bradshaw
Funding Agency: Garden Club of America
Period: annual (2000 to present)
Amount: $500

The Center manages the annual advertisement, review, and selection of recipients for the Garden Club of America Scholarship for Wetland Studies. Each year the Center advertises and responds to inquiries regarding the award. In February it receives, reviews, and ranks applicants and makes a recommendation to the GCA for that year's awards. Awards are open to any graduate student undertaking a field-oriented study of wetlands at an American university.

Website: *http://ccrm.vims.edu/education/garden_club/index.html*

Marine Science Teaching Marsh

Principal Investigators: Hershner, Reay
Funding Agency: Dreyfus Foundation
Period: Private Funds
Amount: $30,000

Funding was provided for improvements to the VIMS Teaching Marsh via improved signage and informational kiosks, updated video cameras, and modifications to the educational website. The website will describe wetland plant species found within the VIMS Teaching Marsh as well as general marsh properties and function. Website information will also include learning activities for children.

Website: *http://ccrm.vims.edu/wetlands/teaching_marsh/index.html*

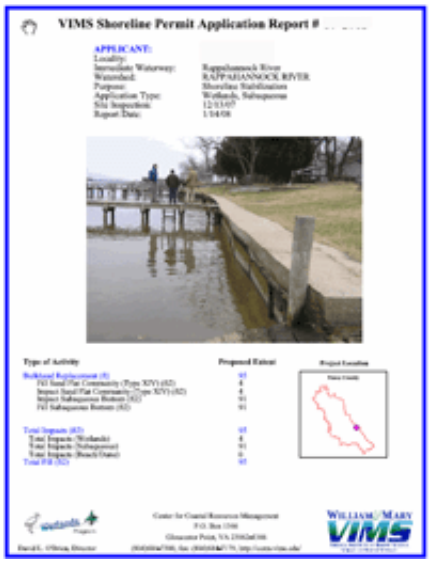
Mid-Atlantic Multi-Level Non-Tidal Wetlands Assessment

Principal Investigators: Havens, Hershner
Funding Agency: EPA
Period: 10/01/07 - 09/30/12
Amount: $460,000

This project implements a level 1 GIS-based protocol for assessment of nontidal wetlands and their functions in the Mid-Atlantic states of Pennsylvania, Delaware, West Virginia, and

the District of Columbia. CCRM and Pennsylvania State University's Cooperative Wetlands Center are collaborating to develop and implement a wetlands assessment protocol for the Mid-Atlantic region. The protocol will synthesize methods currently developed for Pennsylvania, Virginia, Delaware, Ohio and other comparable programs. This project will generate a protocol that can be used for probabilistic sampling and characterization of wetlands in each of the major ecoregions of the Mid-Atlantic.

Wetlands Permit Review and Report Generator



Principal Investigators: Hershner, Berman, Fleming
Funding Agency: in-house
Period: ongoing

This project enhances the permit reporting process to increase the amount of information presented while automating systematic reporting. This is the first system of its kind that combines expert staff review with landscape information retrieved from spatial databases. The report generator is always being modified as new landscape information is available. The reports along with the original application and related photos are posted online in a searchable database.

York River Watershed Planning

Principal Investigator: Hershner, Roggero
Funding Agency: Phillip Morris
Period: 02/01/08 - 06/01/09
Amount: $45,348

This project involves assessment of the information available to develop guidance for establishing minimum instream flow requirements in the tidal freshwater portions of the York River system. Existing MIF methods are being reviewed and aquatic habitat requirements are being synthesized. Recommendations for both interim management strategies and future development of guidance will be generated, along with outreach materials for watershed localities.

Identification of Management Strategies for Promoting Aquaculture in Virginia

Principal Investigator: Mason

Funding Agency: VA Coastal Zone Management Program / NOAA
Period: 07/01/07 – 06/01/08
Amount: $25,000

This review will identify options for the promotion of shellfish culture generally, as well as options specific to oyster culture. Economic analyses of management options identified pursuant to this proposal are to be conducted Virginia Polytechnic Institute and State University (VT). The management analysis proposed herein, will continue to be refined collaboratively with VT during the course of their proposed study in order to identify new management approaches to optimize public and private benefits from aquaculture.

http://ccrm.vims.edu/publications/projreps/Aquaculture_Promotion_Strategies_final.pdf

Integrated Guidance Project

Principal Investigators: Mason, and staff
Funding Agency: in-house
Period: ongoing

Virginia is battling to change the current trend toward environmental degradation. The effects of direct, secondary and cumulative impacts have had significant adverse impacts on water quality, habitat and aquatic resources. It has become increasingly apparent that in order to reduce the cumulative and secondary impacts of activities within the multiple jurisdictions and multiple management programs affecting the littoral and riparian zones, better coordination and integration of policies and practices is necessary. The concept of integrated coastal management embodied by sustainability, adaptability and effective coordination provides a framework to address the current problems inherent in coastal management generally, and shoreline management specifically. There are currently a variety of local and state programs managing shoreline development activities. Each of these programs have their own set of regulatory and guidance documentation. And each managed resource, or jurisdictional area, offers various ecosystem services that are valued by society. These services include water quality maintenance and improve-

ment, terrestrial and aquatic wildlife habitat and recreational amenities to name a few. What is lacking is comprehensive guidance from an ecosystem perspective to promote an integrated management approach for the many regulatory programs that have some responsibility for coastal, shoreline resources. This project involves the development of comprehensive guidance for shoreline management based on ecosystem services. Various combinations of riparian and littoral condition will be modeled for two services; habitat and water quality. The impacts of various shoreline development practices will be assessed based upon those services, and environmental preferences that minimize adverse impacts and/or maximize beneficial outcomes will be identified.

Link to more information - http://ccrm.vims.edu/permits_web/guidance/index.html

Recommendations for Revision of the Dunes/ Beaches Guidelines

Principal Investigators: Mason, Bradshaw, Duhring, Hardaway, Varnell
Funding Agency: VA Coastal Zone Management Program / NOAA
Period: 10/01/07 – 09/30/08
Amount: $50,000

There are currently a variety of regulations and guidelines developed by local and state programs managing shoreline development activities. Development of proposed revision to the Dunes/ Beaches Guidelines document is part of CCRM's on-going integrated guidance initiative. The Dunes/ Beaches Guidelines will be based upon the current scientific understanding of the ecology of beaches and dunes wetlands and role in the landscape.

Recommendations for Revision of the Wetlands Guidelines

Principal Investigators: Mason
Funding Agency: VA Coastal Zone Management Program
Period: 10/01/07 – 09/30/08
Amount: $45,000

The Center for Coastal Resources Management, VIMS, has undertaken an initiative to provide integrated scientific guidance for better-informed decision-making regarding Virginia's shoreline systems. We are working on a revised Wetland Guidelines document on a parallel

track with our on-going comprehensive guidance initiative. The Wetlands Guidelines will be based upon the current scientific understanding of the ecology of wetlands and role in the landscape. The document will provide an overview of the state of the science and identify environmental preferences and supporting rationale for shoreline management options.

http://ccrm.vims.edu/publications/projreps/08_Oct_Wetlands_Guidelines.pdf

Advisory Activities

Advisory Activity

CCRM staff participates regularly in a broad range of advisory activities- that is providing advice to individuals and groups of private citizens, resource managers, and decision-makers. Our advisory activities include responding to phone call and email requests for information; field visit consultations; membership and participation on local, state and regional workgroups and committees; written advice on tidal shoreline projects through the joint permit application process; the publication of newsletters and special reports; giving talks; as well as providing training and special topics workshops.

	Information Requests	Additional Site Visits/ Field Consults	Meetings	Advisory Reports/ Publications	Permit Website Hits
January	200	7	20	55	423
February	191	16	20	44	442
March	189	12	19	45	450
April	201	3	13	55	390
May	242	10	15	35	352
June	171	6	11	61	2696
July	126	6	14	31	552
August	162	1	26	53	400
September	142	6	10	45	287
October	176	3	21	56	299
November	135	3	9	50	2018
December	128	0	20	48	262
Total	2063	73	198	578	8571

Advisory Committees

CCRM Staff provided service on the following advisory committees:

Albemarle Pamlico National Estuary Program Policy Committee

Albemarle Pamlico National Estuary Program North Carolina Comprehensive Conservation and Management Plan Steering Committee

Albemarle Pamlico National Estuary Program Scientific and Technical Advisory Committee (STAC)

Albemarle Pamlico Scientific and Technical Advisory Committee (STAC) Executive Committee

Chesapeake Bay National Estuarine Research Reserve (CBNERR) Coastal Training Program Advisory Board

Chesapeake Bay Local Assistance Division (CBLAD) Technical Advisory Committee

Chesapeake Bay Program (CBP) Scientific and Technical Advisory Committee

Chesapeake Bay Program (CBP) Sediment Workgroup

Chesapeake Bay Program (CBP) Wetlands Assessment Team

Chowan River Basin Roundtable

Department of Environmental Quality (DEQ) Academic Advisory Committee

Department of Environmental Quality (DEQ) Virginia Coastal Policy Team

Mid-Atlantic Wetlands Workgroup

Middle Peninsula Planning District Commission (PDC) Use Conflict (Aquaculture) Steering Committee

US Army Corps of Engineers (COE) Lynnhaven River Restoration Study Steering Committee

US Climate Change Science Program - Adaptation Options for Climate-Sensitive Ecosystems and Resources Advisory Committee

US Climate Change Science Program - Coastal Elevations and Sea Level Rise Advisory Committee

US Coast Guard Area Contingency Planning Committee

Virginia Geographic Information Network (VGIN) State GIS User Group

Virginia Association of Wetlands Professionals

Virginia Marine Resources Commission (VMRC) Habitat Management Advisory Committee

Virginia Stream Alliance

Virginia Waters Advisory Committee

York River Watershed Roundtable

Outreach Education Classes

Regional Integrated Shoreline Management

On the Road Workshops

Web Site: http://ccrm.vims.edu/publications/publications_topics/vwr/vwr_2008_spring.pdf

In 2008 Wetlands Program staff traveled to put on four regional "Integrated Shoreline Management" workshops. This marks the beginning of our effort to take the integrated shoreline message "On the Road" where smaller gatherings allow for more discussion and interaction. This series of regional workshops provides an introduction to the practical application of integrated shoreline management. Topics include discussion of ecosystem services, determination of erosion risk and indicators, determination of preferred shoreline treatments and their impacts, as well as basic training in jurisdiction determination, tidal wetland delineation, pre-application strategies, and permit processing and evaluation. The half-day workshops targeted Wetlands Board and Chesapeake Bay Board staff, and were coordinated through the Planning District Commissions in an effort to assist them in accomplishing this portion of their jobs.

April 28, 2008	Middle Peninsula PDC
May 28, 2008	Hampton Roads PDC - West
October 9, 2008	Eastern Shore PDC
November 20, 2008	Northern Neck PDC

Tidal Wetland Plant Identification Workshop (co-sponsored with CBNERRVA)

August 22, 2008 (72 attended)

Web Site: http://ccrm.vims.edu/education/seminarpresentations/plant_id_wkshp.html

- Wetland Plants: Regulations and Restoration (Walter Priest, NOAA Restoration Center)
- How to Identify Grasses, Sedges and Rushes (Doug DeBerry, Vanasse Hangen Brustlin, Inc.)
- Tidal Wetland Plant Identification (James Perry, VIMS Biological Sciences)
- Invasive / Rare Vascular Plant Species (James Perry, VIMS Biological Sciences)
- VIMS Teaching Marsh (Wetlands Program staff)

A field session in breakout groups allowed for hands-on identification of common salt and brackish marsh plants. With a basic understanding of plant identification, participants were able to explore how to determine Virginia tidal wetland jurisdictional boundaries, recognize biological indicators of tide levels, and ways to estimate project impacts.

Putting Nature to Work: How to Design and Build Living Shoreline Projects

Tidal Wetlands Seminar (161 attended)

October 24, 2008

Web Site: http://ccrm.vims.edu/education/seminarpresentations/fall2008/index.html

This workshop was held at VIMS for marine contractors, permitting agents, environmental consultants, local government staff, and advisory board member interested in the living shoreline approach for habitat restoration and erosion protection. The sessions provided guidance for understanding how land use and shoreline management choices determine the health of the aquatic ecosystem and how to select the best erosion protection method.

- Reality Check: Why Are More "Living" Shoreline Projects Needed & Where Are They Suitable?
- Non-Structural Methods for the Upland Area (Pat Menichino, James City County)
- Design Criteria for Planting Tidal Marshes (Walt Priest, NOAA Restoration Center)
- Planted Tidal Marshes and Fiber Log Projects in Norfolk, VA (Kevin DuBois, City of Norfolk)
- Beach Nourishment and Dune Planting
- Hybrid Method Design and Case Studies (Scott Hardaway, VIMS Shoreline Studies program)
- Estimating Costa and Construction Materials (Brian Barnes, Lancaster County)
- Putting It All on Paper: How to Translate Design Into Permit Application Drawings

On-line Courses and Tutorials

- Living Shoreline Design for Marine Contractors

Web Site: http://ccrm.vims.edu/education/ls_design_class/index.html

The Center with funding from the Chesapeake Bay Restoration Fund, developed curriculum for a course to educate shoreline project designers and contractors about the use of "Living shoreline" designs. The course stresses the reasoning behind the recommended design criteria and the interactions between upland riparian zones, wetlands and the aquatic system – three areas that are functionally integrated and tend to be impacted by shoreline projects. There are three main objectives of the course; ecosystem services, site suitability, and design criteria.

- Instructions for Complete Joint Permit Applications

Web Site: http://ccrm.vims.edu/permits_web/CompleteJPAInstructions.html

As part of its advisory role in evaluating the marine environmental impacts of proposed projects, the Wetlands Program staff reviews Joint Permit Applications (JPA) for completeness. When an application does not include the minimal information necessary for VIMS to provide relevant project-specific recommendations, the application is considered incomplete. An online tutorial was created to provide instructions on the information necessary to correctly complete the JPA.

Master Gardeners and Master Naturalists Training

The Center provides field trips, public seminars and technical support for the Virginia Master Gardeners and Master Naturalists programs. Volunteers in these programs provide unbiased, research-based horticultural and natural heritage information to citizens in every locality of the commonwealth. The training and seminars provided by the Center help local chapters meet their obligations to learn and then teach others about environmental horticulture, water quality, erosion control and coastal habitats.

March	Northern Neck chapter annual public workshop
July	Middle Peninsula-Northern Neck chapters' continuing education seminar
September	James City-County chapter field trip to VIMS habitat demonstration areas

Tours and Talks

In 2008, the Center gave approximately 21 talks to nearly 1200 participants on topics related to integrated shoreline management, sea level rise, shallow water habitat, marshes, living shorelines & landscapes, water quality & protection, marine debris, land use, coastal processes, aquaculture and the Chesapeake Bay.

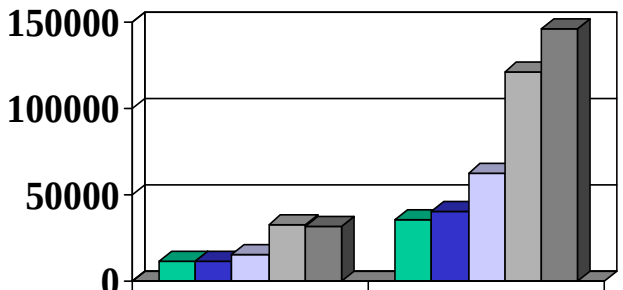
CCRM Website Report

ccrm.vims.edu

In 2008, the CCRM Web usage program reports 31,739 unique visitors accessed the site with 146,276 total visits. Visitors came from 41,240 distinct Internet addresses. A typical visitor examined 11.44 distinct files before leaving the site and a typical visit lasted for 10.95 minutes.

Compared with 2007, there were 873 fewer unique visitors in 2008, but an increase of 25,483 total visits to the system, as well as an increase of 5.25 minutes of average visit time.

The top CCRM website entry pages included the CCRM Index Page, Teaching Marsh, Shoreline Permit Scans, and Wetlands Board Discussion Bulletin Board.



	Unique Visitors	Number of Visits
2004	11137	35655
2005	11354	40246
2006	15,560	62,567
2007	32,612	120,793
2008	31,739	146,276

Chart 1: CCRM Web Usage Comparison 2004 - 2008

Publications

Center Publications

CCRM produces two newsletters – the Virginia Wetlands Report and the Rivers & Coast. The Virginia Wetlands Report informs readers of near-shore environmental science and related issues in an effort to influence better tidal shoreline decisions, and serves to announce upcoming workshops and educational opportunities, both inside and outside of VIMS. The Rivers & Coast newsletter is designed to keep readers well informed of current scientific understanding behind key environmental issues as they apply to watershed rivers and coastal ecosystems of the Chesapeake Bay. This newsletter is written for three perspectives – the general public, managers or decision-makers, and legislators – and provides information that goes from the big picture down to local relevance. Both newsletters were mailed to over 1900 individuals, including all local wetlands board members, local and state agency personnel, General Assembly members, and interested private citizens. In addition to being distributed for free and available to any interested subscriber, they are available online.

Virginia Wetlands Report, Spring 2008, Vol. 23, Issue 1, "On the Road with CCRM"
http://ccrm.vims.edu/publications/publications_topics/vwr/vwr_2008_spring.pdf

Rivers and Coast, Fall 2008, Vol. 3, No. 1, "Connecting Science and Management for Virginia's Tidal Wetlands"
http://ccrm.vims.edu/publications/pubs/rivers&coast/vol3_no1_science&mgt.pdf

Virginia Wetlands Report, Fall 2008, Vol. 23, Issue 2, "Putting Nature to Work: How to Design & Build Living Shoreline Projects"
http://ccrm.vims.edu/publications/publications_topics/vwr/vwr_2008_fall.pdf

Peer Reviewed Publications:

Bilkovic, D. and M. Roggero. 2008. Effects of Coastal Development on Nearshore Estuarine Nekton Communities. Marine Ecology Progress Series 358:27-39.

Havens, K., D. Bilkovic, D. Stanhope, K. Angstadt and C. Hershner. 2008. The Effects of Derelict Blue Crab Traps on Marine Organisms in the Lower York River, Virginia. North American Journal of Fisheries Management 28(4):1194-1200.

Olney, J., D. Bilkovic, C. Hershner, L. Varnell, H. Wang, and R. Mann. 2008. Six Fish and 600,000 Thirsty Folks – A Fishing Moratorium on American Shad Thwarts a Controversial Municipal Reservoir Project in Virginia, USA. In Nielsen, J., J. Dodson, K. Friedland, T. Hamon, N. Hughes, J. Musick, and E. Verspoor, editors. Proceedings of the Fourth World Fisheries Congress: Reconciling Fisheries with Conservation. American Fisheries Society, Symposium 49, Bethesda, Maryland. 1,946 pages/2 volumes.

Shen, J. and J. Herman. 2008. Using a Linked Receiving Water and Watershed Modeling System to Support Management of Bacterial Sources for Poquoson River Basin in the Chesapeake Bay. Bioinformatics and Biomedical Engineering, 2008. ICBBE 2008. The 2nd International Conference on. pp. 3621-3624. doi: 10.1109/ICBBE.2008.407.

Shen, J., T. Wang, J. Herman, P. Mason, and G. Arnold. 2008. Hypoxia in a Coastal Embayment of the Chesapeake Bay: A Model Diagnostic Study of Oxygen Dynamics. Estuaries and Coasts 31(4):652-663.
http://dx.doi.org/10.1007/s12237-008-9066-3.

Varnell, L., D. Evans, D. Bilkovic, and J. Olney. 2008. Estuarine Surface Water Allocation: A Case Study on the Interactive Role of Science in Support of Management. Environmental Science and Policy 11(7):602-612.

Chambers, R.M., K.J. Havens, T.M. Russell, S. Killeen, and M. Berman. In Press. Common Reed Phragmites Australis Distribution in the Chesapeake Bay Watershed. Wetlands.

Havens, K., D. Bilkovic, D. Stanhope, and K. Angstadt. In Press. Location, Location, Location: The Importance of Cull Ring Placement in Blue Crab Traps. Transactions of the American Fisheries Society.

Perry, J., D. Bilkovic, K. Havens, and C. Hershner. In Press. Book Chapter: Tidal Freshwater

Marshes of the Mid-Atlantic and Southeastern United States. In Tidal Freshwater Wetlands, pp. 157-166. Edited by A. Barendregt, D.F. Whigham, A.H. Baldwin; Backhuys Publishers, Leiden, The Netherlands.

Havens, K.J., C. Hershner, D.M. Bilkovic and D.H. Wardrop. 2007. Assessment of Chesapeake Bay Program Selection and Use of Indicators. EcoHealth. 4(2):187-193. http://www.springerlink.com/content/d700vn2j517t4662/fulltext.pdf

Wardrop, D.H., C.H. Hershner, K. Havens, K. Thornton and D.M. Bilkovic. 2007. Developing and Communicating a Taxonomy of Ecological Indicators: A Case Study from the Mid-Atlantic. EcoHealth. 4(2):179-186. http://www.springerlink.com/content/k856nq840331w401/fulltext.pdf

CCRM Quality Assurance/ Quality Control Policy

The Center for Coastal Resources Management conducts applied research and serves as a scientific advisor to federal, state and local agencies, and the general public. The Center recognizes the importance of how work processes are implemented to ensure that data collected are of the needed and expected quality for their desired use. In order to provide accurate information to user groups, the CCRM is dedicated to an aggressive, proactive Quality Assurance and Quality Control program. A myriad of activities occur within the Center, including direct support of laboratory and field investigations, support and training of graduate students and interns, training of resource agency personnel and the public, direct support of state agencies and local governments, and sponsorship of lectures, seminars, conferences and visiting scientists. Research activities include both field and laboratory measurements and the development and validation of ecological models. The general goal of the CCRM Quality System is to ensure accurate, reproducible, and unbiased data**.**

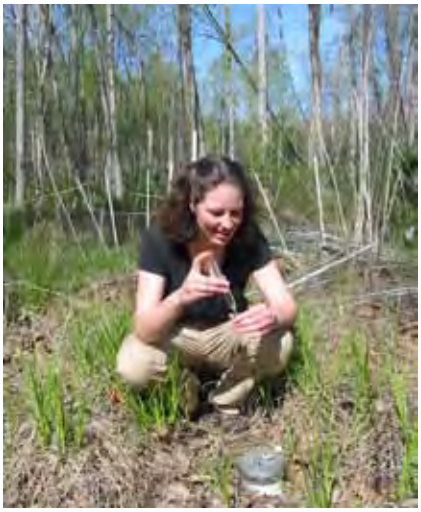
Operational Procedures

The Center recognizes the need for specific plans for individual data collection operations to ensure that data or information collected are of the needed and expected quality for their desired use. As a Center, the quality assurance operation procedures differ from that of an individual research contract. Each principal investigator is responsible for submitting a project-specific quality assurance plan to the relevant Program Quality Assurance Manager and the Center Quality Assurance Manager. The principal investigators will use the underlying principles described in this document as a framework for the specific quality assurance and quality control plans for each project. These plans should detail:

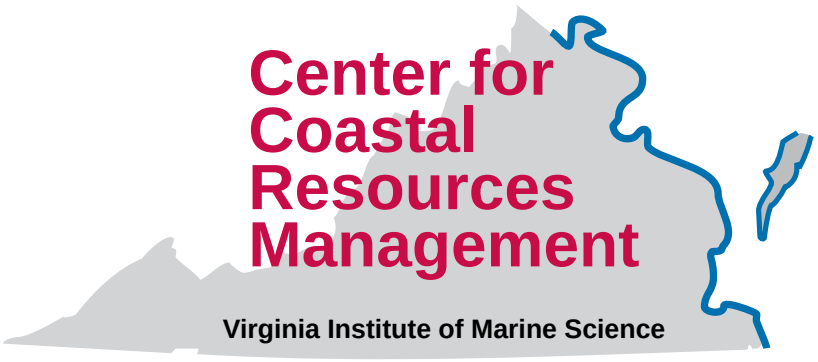
- The specific objectives of the project, including the hypothesis to be tested.
- The data quality objective for the variables to be measured.
- The specific sampling and analytical protocols required to meet the data quality objective.
- The individual responsible for quality assurance for the project.

All noncompliance or deviation from the approved quality assurance plan will be reported to the Program Quality Assurance Manager and the Center Quality Assurance Manager. More information about CCRM QA/QC can be found at

http://ccrm.vims.edu/about_us/QAQC/qaqc.html




Mapping:
Finding Your Way



http://ccrm.vims.edu/